We claim:

1. A sensor for determining a length of an optical path, the sensor comprising:

a light source (102) configured to direct light along said optical path;

at least one modulator (116, 118) optically coupled to said light source (102), said at least one modulator (116, 118) configured to modulate at least a portion of said light as a function of a modulation signal;

a detector (108) optically coupled to said at least one modulator (116, 118) configured to produce a detector output based upon a sensed intensity of said light at the end of said optical path; and

an electronic system (126) configured to receive said detector output (130), and to provide an output indicative of the optical path length.

2. The sensor of claim 1, wherein said modulation signal as a function of said detector output (130) to produce a desired effect upon said light, whereby said length of said optical path is determined by said electronic system as a function of said modulation signal that produces said desired effect.

3. The sensor of claim 1, further comprising an optical splitter (120) optically coupled between said light source (102) and said at least one modulator (116, 118), whereby light passing through said optical splitter (120) is split into a first path (132) and a second path (134).

4. The sensor of claim 3, wherein said detector output (130) is indicative of the difference in phase in the light traveling along said first path (132) and said second path (134).

5. The sensor of claim 1, wherein said modulation signal is generated at a frequency that is a function of the length of said optical path.

6. The sensor of claim 5, wherein said electronic system (126) adjusts a frequency of said modulation signal in response to changes in said detector output (130) to maintain said modulation signal at a frequency based upon said optical path.

7. A method of determining a length of an optical path, the method comprising:

generating a light along the optical path;

splitting said light into a first beam (132) and a second beam (134);

modulating at least one of said first beam (132) and said second beam (134) in response to a modulation signal to induce a difference between said first beam (132) and said second beam (134);

re-combining said first beam (132) and said second beam (134) to generate a recombined signal;

detecting an output intensity of said recombined signal at a detector (108);

adjusting said modulation signal as a function of said output intensity; and

computing said length of said optical path as a function of said modulation signal.

8. The method of claim 7, wherein said adjusting said modulation signal comprises maintaining said modulation signal at a frequency such that said output intensity is maintained substantially constant.

9. The method of claim 7, wherein said difference between said first beam (132) and said second beam (134) is a phase difference.

10. The method of claim 7, wherein said modulation signal is a ramp waveform having a given frequency.

11. The method of claim 7, further comprising applying said modulation signal to said second beam (134) after a delay has elapsed since application of said modulation signal to said first beam (132), such that said delay is based upon said length of said optical path.

12. The method of claim 11, wherein said adjusting of said modulation signal comprises sampling said output intensity to determine differences in said output intensity over time.

13. The method of claim 12, wherein said adjusting of said modulation signal further comprises altering the frequency of said modulation signal to reduce said differences in said output intensity over time.

14. The method of claim 13, wherein said adjusting of said modulation signal comprises determining a proper frequency for said modulation signal such that differences in said output intensity are minimized over time.

15. The method of claim 14, wherein said computing of said length comprises determining said length of said optical path from said proper frequency.

16 . A system (100) for determining the length of an optical fiber under test (150), the system comprising:

a low coherence white light source (102) configured to send light along an optical path defined by an optical fiber;

a phase modulator (107) optically coupled to the white light source (102) for modulating at least a portion of the light in a first path (132) relative to a second path (134);

a detector 108 optically coupled to the optical path (107) for producing a detector output (130) based upon a length of the optical path; and

a processor (126) for receiving the detector output (130), and for producing an output based on the length of the optical path, wherein the white light source (102) has a coherence length shorter than a difference in said length between the first path (132) and the second path (134).

17. The system of claim 16, further comprising a coupler between the white light source (102) and the phase modulator (107).

18. The system of claim 17, wherein said coupler is a 2 x 2 coupler (104).

19. The system of claim 16, further comprising a delay fiber (122) optically coupled to said fiber.

20. The system of claim 16, further comprising a connector (124) for probing optical transducers at the end of a section of the optical fiber.

21. The system of claim 16, further comprising telescope optics for transmitting and collecting light from objects or from the air.

22. The system of claim 16, wherein the processor (126) receives the detector output (130), such that the length of the optical path traveled by said light is determined.

23. The system of claim 16, wherein the processor (126) receives the detector output (130) such that a break fault in the fiber under test (150) is determined.

ABSTRACT

A fiber optic fault detector and generic fiber optic sensor system (100) for detecting breaks in an optical fiber under test (150) using a low coherence interferometric technique. The system (100) comprises a light source (102) configured to produce light traveling along an optical path, a modulator (107) optically coupled to the light source. The modulator (107) is configured to modulate at least a portion of the light as a function of a modulation signal. A detector (108) is optically coupled to the modulator (107) and is configured to produce a detector output based upon a sensed intensity of the light. An electronic array (126) is configured to receive the detector output and determine the optical fault. The low coherence interferometric technique allows for detection of a fault in the fiber under test (150) with a minimal amount of test equipment and with higher measurement sensitivity and resolution. The system (100) may alternatively include a transducer, positioned in place of the fiber under test (150), having a response which changes in reflective or optical path length. The system (100) can be used in a LIDAR system, wherein telescope optics are used in place of the fiber under test (150), to transmit light and collect light scattered from objects or from the air.

Figure 1